The Monthly Evening Sky Map

A SCIENTIFIC JOURNAL AND EDUCATIONAL GUIDE IN ASTRONOMY FOR THE AMATEUR

Founded in 1905 by Leon Barritt

ALSO A STAR, CONSTELLATION AND PLANET FINDER MAP ARRANGED FOR THE CURRENT MONTHS - MORNING AND EVENING - AND PRACTICAL ANYWHERE IN THE WORLD

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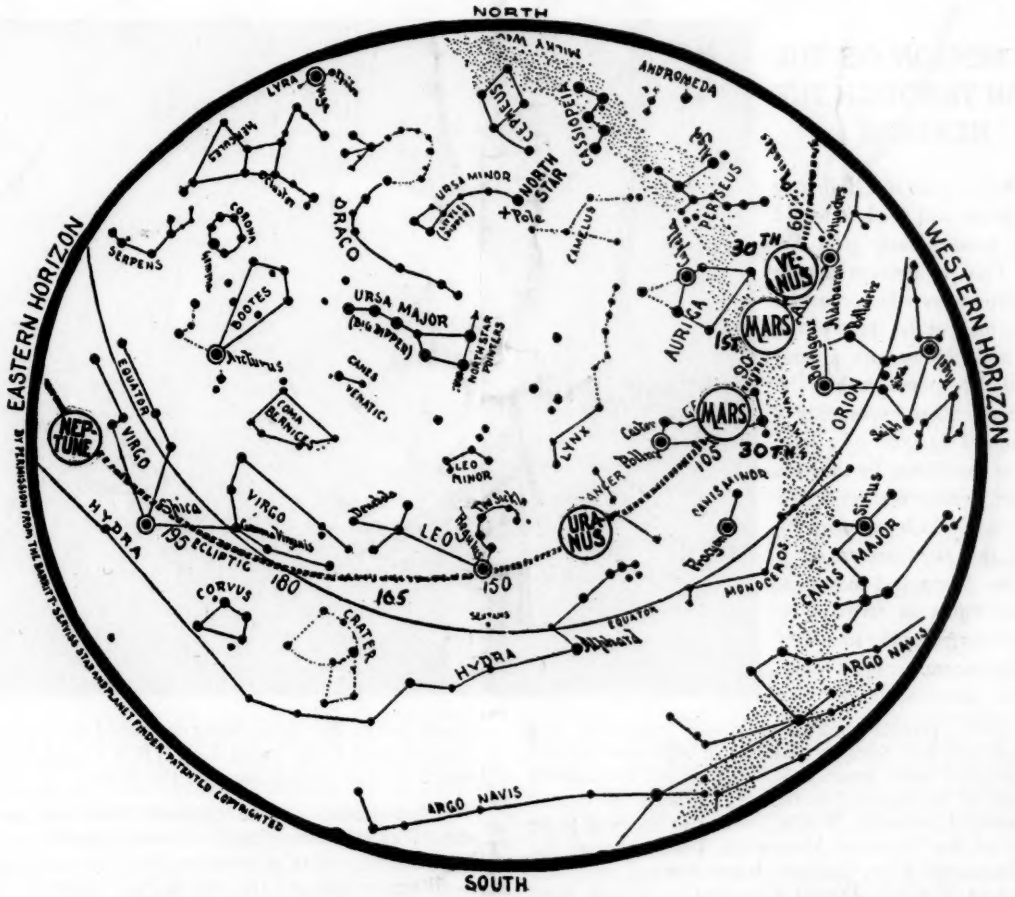
EVENING SKY MAP FOR APRIL



AT 9:30 P.M., APRIL 1 8:30 P.M., APRIL 15 7:30 P.M., APRIL 30

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper.

This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States, the southern portion of Canada and the northern portion of Mexico and for corresponding latitude in Europe.

THE DATE BELOW EACH NUMERAL WILL SHOW WHEN THAT SECTION OF THE MAP BECOMES USEFUL FOR EACH NUMERAL EAST. FOR EACH NUMERAL WEST OF THIS DATE AND AN HOUR LATER FOR EACH NUMERAL EAST.

XUM

THE STUDY OF OUTER SPACE

By A. C.Cook

Man has entered the Space Age, even though it might be argued that only a bare scratching of the surface was accomplished when the United States and Russia placed their first small satellites in orbit around the earth.

The vital significance of these successful man-made moon launchings can not be minimized, however, for before we can hope to determine requirements for human survival in outer space, mountains of scientific data must be compiled and evaluated. Only through such satellites can we obtain it. The complex nature of these data staggers the imagination involving, as it does, the vast reaches of both time and space.

At Wright Air Development Center in Dayton, Ohio, (perhaps best known as WADC) scientists and electronic data-processing experts of the United States Air Force are working tirelessly to help solve the problems of space travel. Among other efforts, they work in collaboration with the Smithsonian Astrophysical Observatory and the USAF's Cambridge Research Center.

WADC's project concerns itself with processing data in conjunction with satellite tracking, an important adjunct to the study of outer space. It is being guided by Kenneth E. Kissell, of the Applied Mathematics Branch, Aeronautical Research Laboratory, WADC, who also happens to be Director of the Volunteer Moonwatch Team covering the Dayton area; and Clem Grabner, James Atwood, and their associates in WADC's Digital Computation Branch. Keystone of the project is the Remington Rand *Univac* Scientific 1103 electronic computer.

In common language, the objective of WADC's project is to determine when and where a satellite may be seen by the observers in a given area. The man-made moons are visible only at twilight when they are bathed in sunlight, and the sky over the observation station on the ground is dark so that the satellite stands out against the night sky, and may be seen.

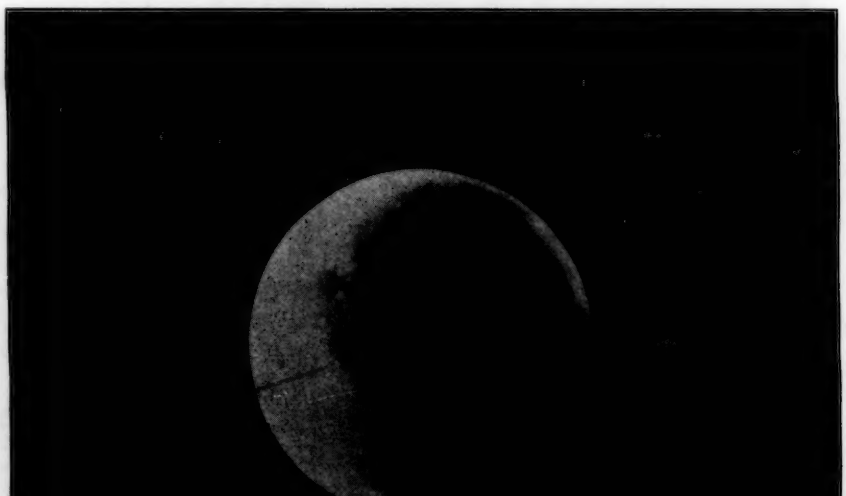
Unless the satellite observers know where to look, and when, they have no chance of spotting the satellite or hearing its signal. The satellite may be visible during a ont to two hour period before sunrise and after sunset. It disappears as soon as it enters the earth's shadow.

Predicting for ground observers, now essentially engaged in testing special apparatus, is one of determining just what path a satellite is following and computing just where it will be in the sky with respect to observers at given times along its path. It should be pointed out that the man-made moons' orbits do not always adhere to a rational pattern. At times they are subject to a marked degree of variation.

Role of the Univac computer is to solve problems in complicated spherical trigonometry in as little as one second, that would require endless hours of work to complete on a conventional resk calculator. The satellite tracking project is also part of the studies being conducted during the current International Geophyscial Year (IGY), and objective of which is to accurately meaeure the earth.

Information can be obtained from satellites on the density of the atmosphere at various heights as functions of the density of solar radiation above the atmosphere, etc. —all versus time, and the true shape of the earth. To arrive at the necessary time history, as determined by the study of the satellites in orbit, it is important to IGY scientists to know the precise location, and the time, this information is obtained from ground observation. The final correlation with the data obtained from the instruments in the satellites themselves will be made by using the information obtained from ground measurements compiled by IGY moonwatch participants.

THE MOTION OF THE MOON THROUGH THE HEAVENS



If a rocket were aimed directly at the Moon and fired, it would miss by a ridiculously great distance. This is because among other allowances which must be made, is that for the speed of the Moon itself in its path around the earth. The photograph to the right represents an exposure of a few minutes duration of a total eclipse of the Moon. By the time the Moon's image had registered on the plate, which was made by guiding the astro-camera on a crater, the Moon had moved about 200 miles, as revealed by the trails created by the stars during the exposure.

EVENING SKY MAP FOR MAY

AT 9:30 P.M., MAY 1 8:30 P.M., MAY 15 7:30 P.M., MAY 31

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper. This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States, the southern portion of Canada and the northern portion of Mexico and for corresponding latitudes in Europe.

"Of Paramount Importance"

From USAF's standpoint, these studies are of paramount importance to manned outer space flight. They were not possible prior to the advent of the International Geophysical Year.

Central source of information regarding the paths of satellites is the Smithsonian Astrophysical Observatory, of which Dr. Fred L. Whipple is director, and Dr. J. Allen Hynek is associate director. All visual observational information goes to the Smithsonian Observatory, where analysis of these raw data is carried out and properties of the orbit deduced to obtain a best fit with the observation.

Properties (or elements) of the orbit are transmitted to WADC, and other USAF organizations equipped with similar electronic computers, by the USAF Cambridge Research Center. On receipt at WADC, this information is fed into the Univac Scientific to yield almost instantly predictions of the satellite's location, height, and distance against time for favorable passages in given areas.

Spacing of predictions is chosen to provide several expected locations in the sky on a single passage, which may last anywhere from four to 12 minutes, depending upon the satellite's height and distance from the observer. The fundamental prediction schemes, or ephemerides, were contributed by the Smithsonian and with some modifications coded for the computer by Messrs. Grabner and Atwood.

Accuracy of the predictions required for tracking depends upon the brightness of the object being observed. For objects of naked eye visibility, only the section of the sky in which they will appear is needed. This can be obtained by considering the time and longitude of the crossing of any chosen parallel of latitude. A spacing of every two degrees of latitude will yield four to eight prediction points.

For faint satellites, instruments with narrow fields of view must be used. In such cases more detailed predictions embodying better orbital elements are necessary.

This latter problem makes desirable the predication of the actual altitude and azimuth which the tracking instrument should use. Accurate prediction in this case requires additional information, together with corrections determined as accurately as possible.

—Continued on Page 7

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The

Monthly Evening Sky Map

FOUNDED IN 1905 BY LEON BARRITT

MRS. LEON BARRITT, Editor
Irving L. Meyer, Managing Editor

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All time is expressed in Eastern (75th Meridian) Standard Time. Add five hours to convert to Greenwich Civil Time.

AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.
APRIL, 1959

THE SUN: following a north-eastwardly path, progresses well into the northern heavens. It moves from Pisces, into Aries. Distance of the earth from the Sun increases from 92.8 million miles the 1st, to 93.6 million miles the 30th.

There is an annular eclipse of the Sun on the 8th, no portion of which is visible from the western hemisphere. The annular phase crosses almost centrally over Australia, but otherwise, aside from a few islands, the path is over the waters of the Pacific and Indian Oceans. New Zealand, portions of the East Indies and Antarctica, and the same oceans will see the partial phases. The apparent diameter of the Moon is about 2' 20" smaller than that of the Sun.

THE MOON: is at *apogee*—farthest from the earth—the 10th at 252,000 miles distance, and is at *perigee*—closest to the earth—the 23rd, at 222,000 miles.

Libration: maximum exposure of the regions on the Moon's limbs takes place as follows:

April 1 South limb, 6.8°
April 2 West limb, 6.5°
April 15 North limb, 6.8°
April 18 East limb, 7.6°
April 28 South limb, 6.8°
April 30 West limb, 7.5°

The Moon's Phases (E. S. T.):

New Moon	April 7 at 10:29 pm
First Quarter	16 at 2:32 am
Full Moon	23 at 12:13 am
Last Quarter	29 at 3:38 pm

MERCURY: makes a very small loop, close to the equator in Pisces and the northern edge of Cetus. It is in the morning sky all month, reaching greatest elongation west of the Sun, 27°, on the 26th. For a few days around that date this difficult planet will be observable in the morning twilight, close to the eastern horizon. It is a little less than one-half illuminated as seen from the earth, and is not particularly bright, averaging about magnitude 1. Phase, principally, causes a large range in brightness; on occasion, Mercury is as bright as -2, and on other occasions as faint as the third magnitude. It is closest to the earth the 2nd at 55 million miles, but by the end of the month this distance has increased to 84 million miles.

VENUS: a wonderful evening sky object, particularly well situated for observers in the northern hemisphere. It moves from Aries into Taurus, far north of the equator. Distance from the earth is decreasing—from 122 million miles the 1st, to 105 million miles the 30th, causing an increase in brightness from magnitude -3.4 to -3.5, during which time the illuminated area decreases from 83% to 74%. During the entire period the planet appears *gibbous* (like the Moon a few days after 1st quarter), and its disc, though almost overpoweringly brilliant, can readily be detected in small telescopes. Diameter averages 13".

MARS: is far past opposition and fading rapidly. Increasing distance (from 148 million miles the 1st, to 173 million miles the 30th) causes magnitude to decrease from 1.3 to 1.6, while apparent diameter decreases from 6" to 5". This planet is much too far away to be of interest to amateur observers. It moves from Taurus into central Gemini, during the month.

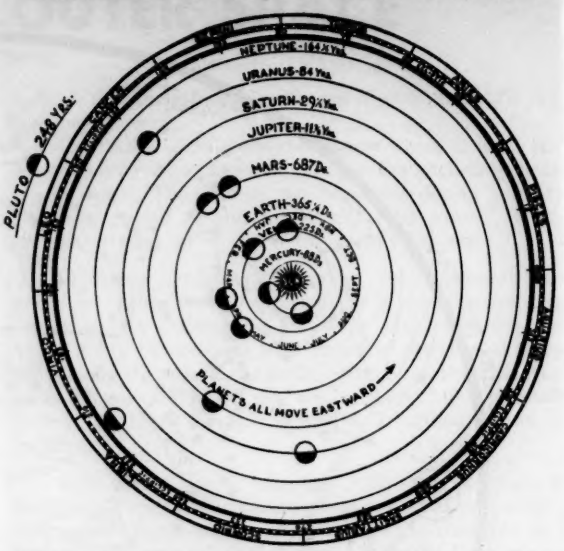
JUPITER: the giant of our solar system is far south of the equator, moving slowly in an area north-west of Antares, in Scorpio. It rises shortly after midnight, and is well placed for observation in the late night sky. Small telescopes can reveal the banded and flattened disc, but probably primary interest is centered about the four bright satellites. Their positions relative to Jupiter are shown on charts, elsewhere in this issue. Distance the 15th is 423 million miles, giving an apparent diameter of 38"—some six or seven times greater than that of Mars.

SATURN: the unique planet, girdled by a ring which is opened some 26° toward the earth and therefor presents a beautiful spectacle in even small telescopes. Cassini's Division can be seen under moderate power. In Sagittarius, it rises a short time after Jupiter, but it too is far south of the equator and best seen from the southern hemisphere. In addition to the ring there are several satellites within range of modest telescopes, brightest of which is Titan. The rings subtend an angular diameter of 38", while the globe of the planet is 17" at the equator. Distance the 15th is 903 million miles.

URANUS: on the Cancer-Leo boundary, sets shortly after midnight. This planet is a remote giant, best seen with optical aid, though at magnitude 6 it can be seen under good conditions with the naked eye. Diameter, at its great distance of 1681 million miles, is slightly less than 4".

NEPTUNE: south of the equator and perched almost exactly on the boundary line between Virgo and Libra, comes to opposition the 26th, at a distance of 2,724,000,000 miles. In spite of Neptune's size, this great expanse of space reduces magnitude to 8, and diameter to 2.5". At best it is a relatively uninteresting object, though 100 diameters with the telescope will show up its dull, grayish disc. It is observable from dusk to dawn, though best situated for the southern hemisphere.

HELIOCENTRIC POSITIONS OF THE PLANETS, APRIL



The planets are shown in their respective orbits. Two positions, one for the first, and one for the last day of the month are given for Mercury, Venus, Earth, and Mars. The arrow indicates the last day of the month. Jupiter, Saturn, Uranus, Neptune, and Pluto are shown in their mean position for the current month.

ASTRONOMICAL CALENDAR

Eastern Standard Time
APRIL, 1959

April	2— 8:— am	Minimum of Algol
	5— 4:49 am	Minimum of Algol
	6— 3:15 pm	Conjunction, Mercury and Moon; Mercury south 0° 2'
	8——— pm	Annular eclipse of the Sun
	8— 1:37 am	Minimum of Algol
	10—11:— am	Mercury in descending node
	10— 4:— pm	Mercury stationary in Right Ascension
	10—10:26 pm	Minimum of Algol
	11— 1:24 am	Conjunction, Venus and Moon; Venus north 4° 42'
	13— 7:15 pm	Minimum of Algol
	14— 5:31 am	Conjunction, Mars and Moon; Mars north 6° 55'
	16—10:— am	Saturn stationary in Right Ascension
	16— 4:04 pm	Minimum of Algol
	17—12:25 pm	Conjunction, Uranus and Moon; Uranus north 5° 27'

19—12:53 pm Minimum of Algol
20— 5:— am Uranus stationary in Right Ascension
20— 6:— pm Mercury in aphelion
22— 9:42 am Minimum of Algol
23— 5:26 am Conjunction, Neptune and Moon; Neptune south 0° 13'
24— 9:— am Venus in perihelion
24— 6:59 pm Conjunction, Jupiter and Moon; Jupiter south 2° 46'
25— 6:31 am Minimum of Algol
26— 5:— am Mercury greatest elongation west, 27° 11'
26— 9:— am Opposition, Neptune and Sun
27— 8:33 am Conjunction, Saturn and Moon; Saturn south 4° 16'
28— 3:20 am Minimum of Algol

AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.

MAY, 1959

THE SUN: follows its accustomed path deeper into the northern skies, traveling from Aries into Taurus. The earth's slightly eccentric orbit increases distance from 93.6 to 94.2 million miles during the month.

THE MOON: at apogee the 7th at 253,000 miles, and at perigee the 22nd at 222,000 miles.

Libration: maximum exposure of the regions on the Moon's limbs takes place as follows:

May 12 North limb, 6.7°
May 16 East limb, 7.6°
May 25 South limb, 6.6°
May 28 West limb, 7.7°

The Moon's Phases (E. S. T.):

New Moon	May 7 at 3:11 pm
First Quarter	15 at 3:09 pm
Full Moon	22 at 7:56 am
Last Quarter	29 at 3:13 am

MERCURY: moves from the Pisces-Cetus area, picks up speed and races through Aries into Taurus. It is in the morning sky all month, and except for a very short period of observability the first few days of the month, it is too close to the Sun. Even the first few days it can only be seen in the morning twilight, and close to the eastern horizon. As with all of Mercury's apparitions, this favors the southern hemisphere. During the month the telescopic appearance of the planet changes from gibbous to almost fully illuminated, and magnitude increases from 0.5 to -1.7, despite an increase in geocentric distance from 85 to 122 million miles.

VENUS: reaches its point of highest penetration into the northern heavens and commences moving toward the south, as it moves from Taurus through most of Gemini. In the evening sky, it glows like a brilliant gem in the west as the sky darkens. Distance from the earth continues to decrease—from 104 million miles the 1st, to 83 million miles the 31st. During this period the illuminated area as seen from the earth decreases fro m73% to 61%, but the decrease in distance causes brightness to increase from magnitude -3.5 to -3.8—far brighter than any other planetary object in the heavens. Apparent diameter increases from 15" to 19", and though the planet presents a sizeable disc in the telescope, little or no surface detail has ever been seen.

MARS: fading rapidly from the evening scene, is not very far east of Venus in the early evening sky. Whereas at a favorable opposition Mars is a very bright object, second only to Venus, it now is so far from the earth (174 million miles the 1st, and 196 million miles the 31st) that its brilliance has been reduced to that of a second magnitude star. At the same time its apparent diameter has shrunk to about 5"—not much greater than Uranus. It moves from Gemini into Cancer during the month.

JUPITER: is retrograding (i.e., moving westward) in Scorpio all month, at a very slow pace. It is in opposition with the Sun on the 18th and except for its great southern declination, is well placed for observation all night. It is closest to the earth this opposition on the 20th at 406 million miles, resulting in an equatorial diameter of 45", a polar diameter of 42" (a very noticeable flattening at the poles even in binoculars), and magnitude of -2.1. The four bright satellites, which could be seen with the naked eye were it not for the overpowering brightness of Jupiter, are wonderfully entertaining, and require no more than opera glasses to be seen. With a moderate sized telescope their occultations, eclipses. and transits are most interesting. At the same time, the cloud bands across the disc of the planet are readily apparent.

SATURN: rises shortly after dark, in Sagittarius. Averaging magnitude 0.4, it is considerably brighter than a standard first magnitude star, and shines with a steady, yellowish light. Its great ring system can be seen in small telescopes, as can several of its satellites. Like Jupiter, this planet's rapid rotation has produced noticeable flattening at the poles, but this flattening can only be observed about every fourteen years, when the plane of Saturn's equator (and also the rings) lies in the proper relation to the earth. We still have several years to wait for the next opportunity.

URANUS: continues to move at a very slow pace on the Cancer-Leo boundary. It is rapidly disappearing from the evening scene, winding up the month only a few degrees east of Mars. Discovered accidently by Herschel, it is the first of the telescopic planets. Distance the 15th is 1727 million miles.

NEPTUNE: just past opposition, on the Virgo-Libra boundary, is too faint to be of great interest. Great telescopes reveal markings of a vague nature on the surface, but it took the spectroscope to reveal its period of rotation. The disc is very small, only 2½" in diameter, and its distance is correspondingly great, 2728 million miles the 15th.

ASTRONOMICAL CALENDAR

Eastern Standard Time

MAY, 1959

May 1—12:09 am Minimum of Algol
3— 7:— am Quadrature, Uranus and Sun
3— 8:58 pm Minimum of Algol
5— 9:43 am Conjunction, Mercury and Moon; Mercury south 2° 27'
6— 5:47 pm Minimum of Algol
9— 2:36 pm Minimum of Algol
12— 4:— am Mars greatest heliocentric latitude north
12—11:25 am Minimum of Algol
12— 9:49 pm Conjunction, Mars and Moon; Mars north 6° 45'
14— 8:10 pm Conjunction, Uranus and Moon; Uranus north 5° 18'
15— 8:14 am Minimum of Algol
16— 8:— am Venus greatest heliocentric latitude north
18— 5:02 am Minimum of Algol
18— 3:— pm Opposition, Jupiter and Sun
20— 3:14 pm Conjunction, Neptune and Moon; Neptune south 0° 11'
21— 1:51 am Minimum of Algol
22—12:43 am Conjunction, Jupiter and Moon; Jupiter south 2° 33'
23—10:40 pm Minimum of Algol
24— 4:19 pm Conjunction, Saturn and Moon; Saturn south 4° 9'
26— 7:29 pm Minimum of Algol
29— 6:— am Saturn in aphelion
29— 4:18 pm Minimum of Algol
30— 2:— am Mercury in ascending node

AMATEUR'S FORUM

BY IRVING L. MEYER, M. S.

JUNE, 1959

THE SUN: passes its highest point in the northern heavens, and by month-end has commenced a slow but accelerating descent toward the south. It leaves Taurus during the month, and enters Gemini. Distance from the earth increases from 94.2 to 94.4 million miles.

THE MOON: is farthest from the earth the 4th at 253,000 miles, and is closest the 19th at 223,000 miles.

Libration: maximum exposure of the regions on the Moon's limbs takes place as follows:

June 9 North limb, 6.6°
June 13 East limb, 6.8°
June 22 South limb, 6.5°
June 25 West limb, 7.3°

The Moon's Phases (E. S. T.):

New Moon	June 6 at 6:53 am
First Quarter	14 at 12:22 am
Full Moon	20 at 3:00 pm
Last Quarter	27 at 5:12 pm

MERCURY: speeds eastward from Taurus, through Gemini, into Cancer. On the 2nd it is in superior conjunction with the Sun, thereupon entering the evening sky, but it remains too close to the Sun all month to be observable, as far as the northern hemisphere is concerned. Toward the close of the month, southern hemisphere observers can see this planet, low in the west after sunset. Magnitude diminishes during June from -1.8 to 0.3, while distance decreases from a high of 123 million miles the 3rd, to 91 million miles the 30th.

VENUS: reaches greatest elongation east of the Sun, 45°, on the 23rd. Exceedingly bright, and relatively close to the earth (and coming closer every day), the United States is scheduled to launch a probe during this month. A probe, if successful will tell more about this planet than the greatest telescopes and related instruments have been able to over the past centuries. A great question

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may be answered—is Venus a watery, pre-dinosaur world, or is it an arid, scorched desert? Venus moves from Gemini, through Cancer, into Leo, in the evening sky. Magnitude increases from -3.8 to -4.0 during the month, as distance decreases from 82 to 60 million miles. Apparent diameter increases from 19" to 26".

MARS: the "Ruddy" planet now shines with vastly reduced splendor in the evening sky, moving through Cancer, into Leo. It sets soon after the Sun. On the 14th it is in conjunction with Venus, being less than 1° to the south of that planet, but Mars is almost 6 magnitudes the fainter, and therefor suffers as a poor companion for the Queen of the skies. Mars' distance increases from 197 million miles, to 215 million miles during the month.

JUPITER: though well past opposition, this giant continues as an interesting and easily-observed planet. Telescopes reveal much of interest, not only on the broad disc of the planet, but also in the activities of the brighter satellites, some of which reveal an appreciable disc. Actually, the largest of these satellites is close to Mercury in size. In Libra, Jupiter is 415 million miles away the middle of the month.

SATURN: a giant planet, second only to Jupiter in size, and unique because of its ring system, plods at a relative snail's pace in Sagittarius. Though it is far south of the equator, northern hemisphere observers will get plenty of good viewing during the calm summer nights. It comes to opposition the 25th, rising at sunset and setting at dawn. Magnitude is 0.2 (a shade fainter than Vega, in Lyra), ring diameter is 41", and geocentric distance at its closest approach to the earth at this opposition, is 841 million miles on the 26th.

URANUS: in Cancer, close to the Leo boundary, is an evening sky object, setting shortly after the Sun. Successively, Venus and Mars are in conjunction with this remote giant; the first on the 19th, and the second on the 23rd. Mars is only a little more than one-half degree to the north at conjunction. Distance of Uranus from the earth the middle of the month is 1770 million miles.

NEPTUNE: this slow-moving planet spends many years in each constellation. It is in Virgo, but close to Libra boundary. It will enter the latter late this year, return to the edge of Virgo next year, then leave Virgo for almost 160 years. In fact, this planet moves so slowly, that since its discovery in the last century, it has not yet completed a full revolution about the Sun. It is faint, in the bargain (magnitude 8), and shows a disc only under fairly high power on the telescope. Distance from the earth is 2755 million miles the 15th.

ASTRONOMICAL CALENDAR

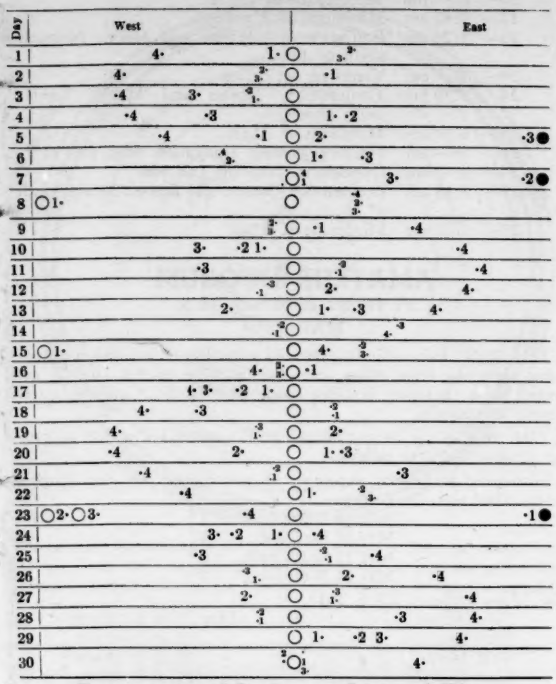
Eastern Standard Time

JUNE, 1959

June	1— 1:07 pm	Minimum of Algol
	2—11:— pm	Superior conjunction, Mercury and Sun; Mercury north 0° 40'
	3— 5:— pm	Mercury in perihelion
	4— 9:56 am	Minimum of Algol
	6— 3:48 pm	Conjunction, Mercury and Moon; Mercury north 5° 56'
	7— 6:45 am	Minimum of Algol
	10— 3:34 am	Minimum of Algol
	10— 9:52 am	Conjunction, Venus and Moon; Venus north 7° 5'
	10— 1:15 pm	Conjunction, Mars and Moon; Mars north 6° 4'
	11— 3:32 am	Conjunction, Uranus and Moon; Uranus north 5° 2'
	13—12:23 am	Minimum of Algol
	14—12:00 am	Mercury greatest heliocentric latitude north
	14— 8:— am	Conjunction, Venus and Mars; Venus north 0° 51'
	15— 9:12 pm	Minimum of Algol
	16—11:45 pm	Conjunction, Neptune and Moon; Neptune south 0° 18'
	17—11:— pm	Mars in aphelion
	18— 6:02 am	Conjunction, Jupiter and Moon; Jupiter south 2° 30'
	18— 6:01 pm	Minimum of Algol
	19—10:— pm	Conjunction, Venus and Uranus; Venus north 1° 17'
	20—11:51 pm	Conjunction, Saturn and Moon; Saturn south 4° 4'
	21— 2:50 pm	Minimum of Algol
	21—10:50 pm	Sun enters the *sign* of Cancer; Solstice
	23— 3:— am	Venus greatest elongation east, 45° 25'
	23— 7:— pm	Conjunction, Mars and Uranus; Mars north 0° 39'
	24—11:38 am	Minimum of Algol
	25—10:— pm	Opposition, Saturn and Sun
	27— 8:27 am	Minimum of Algol
	30— 5:16 am	Minimum of Algol

SATELLITES OF JUPITER

APRIL



Appeaance of Jupiter and its satellites at 2:45 A.M., E.S.T. as seen in an inverting telescope

RELATIVISTIC ADVANCES OF PERIHELIONS

DONALD C. MORTON

Newton's law of gravitation predicts that the path of each planet will deviate slightly from an ellipse because of the attractions of the other planets. This deviation is usually described as the advance of the perihelion, the point of the orbit nearest the sun. While the planet moves in an ellipse the longest diameter of the ellipse slowly rotates in the direction the planet is moving. However, Einstein's general theory of relativity, because of the so-called curvature of space in the vicinity of matter, predicts an advance of the perihelion which is slightly in excess of the non-relativistic motion of the planet.

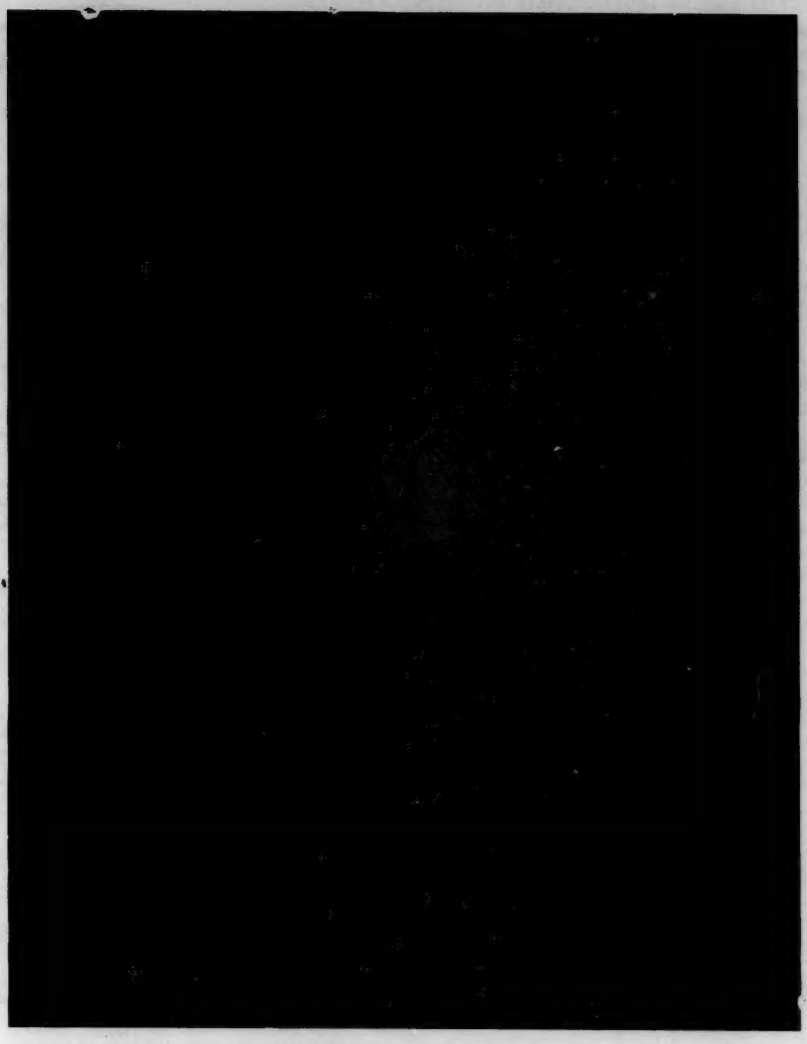
At the March 1956 meeting of the American Astronomical Society, R. L. Duncombe, of the U. S. Naval Observatory, announced results for the planet Venus derived from his recent analysis of many thousands of observations made from 1750 to 1949. For the first time the observational results have been accurate enough to detect the relativistic effect for Venus. Duncombe quoted the following values and probable errors for the advance of the perihelions of Mercury, Venus and Earth which are in excess of those predicted by all known Newtonian forces. G. M. Clemence derived the figures for Mercury, and Clemence, H. R. Morgan and Duncombe derived those for Earth. The observed discrepancies are followed by the predicted relativistic motions calculated by Clemence. All values are in seconds of arc per century.

	MERCURY	VENUS	EARTH
Observed Discrepancy	43".11	8".4	5".0
Relativistic Prediction	43".03	8".6	3".8

For each planet the two values agree within the probable errors. This close agreement between observed and predicted values gives considerable suport to the general theory of relativity.

—*Journal of The Royal Astronomical Society of Canada*

A GLOBULAR STAR CLUSTER



M3 in Canes Venatici

This is a fine example of a globular cluster—thousands of stars grouped about a common center. This particular cluster can be seen with the naked eye. Binoculars will expand it to a misty patch of light, while telescopes, preferably twelve inch diameter and upwards, will resolve many of the individual stars. However, only photography can bring out the true beauty of this type of cluster. This cluster, M3, is about 10° north-west of Arcturus. Take your binoculars, preferably those high light gathering 7 x 50's, and sweep the region to the west and north of Arcturus. Many misty patches of light, representing both galaxies and clusters, will come into view. Then swing the binoculars to Hercules, and pick up there the Great Cluster, M13, the most famous globular cluster of all.

THE STUDY OF OUTER SPACE—Continued from Page 1

The computer mathematically produces predictions of when and where to look for a given satellite, and permits the WADC project crew to establish the brightness to be expected. It also makes possible evaluation of these predictions, and observations in terms of accuracy, so that the scientists may determine how to improve the work of tracking these man-made moons.

Somewhat less than a handful of satellites are presently whirling through space. But even if a traffic jam should occur some day, the Univac system should be equal to the task of keeping track of their movements.

The system at WADC—an even faster one is currently in process of installation—can add in one second over 30,000 10-digit numbers, and each of these has either a plus or minus sign. Information stored in the system's memory units can be retrieved for use in one eight-mil lionths of a second.

"Less than 20 years ago the work now being done at WADC wouldn't have been even remotely possible," Mr. Kissell observed. "If the information is not processed quickly, it is of no value. The end answer must be available at least in minutes, not hours, and only the tremendous speed and accuracy of the Univac Scientific makes this possible."

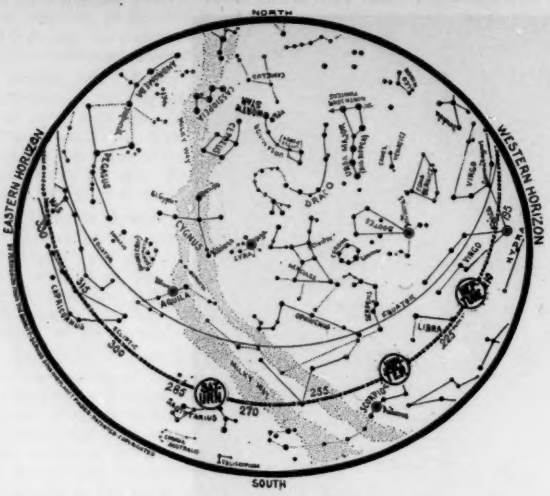
Earth-Moon Trajectory Problems

Satellite tracking is not the only function of the WADC computer. Another vital project is in solving earth-moon trajectory problems. Primary computer input data are

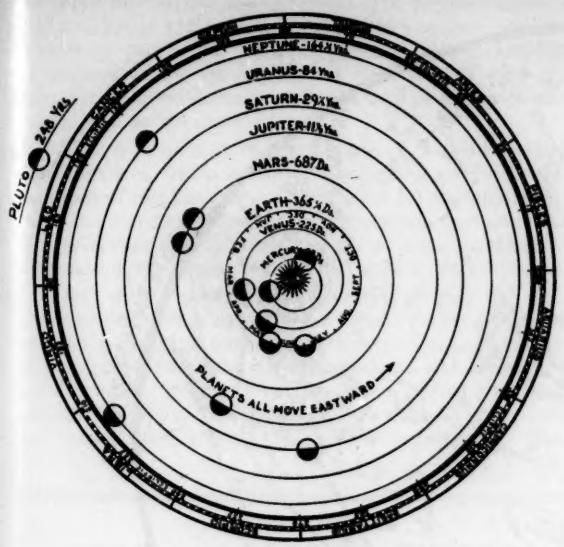
—Continued on Page 11

XUM

MORNING SKY MAP FOR APRIL


NORTH
EASTERN HORIZON
WESTERN HORIZON
SOUTH
CYGNUS
DRACO
CAPRICORNUS
AQUARIUS
SAGITTARIUS
LIBRA
VIRGO
CORONA BOREALIS
HERCULES
OPHIUCHUS
SCORPIUS
ECLIPTIC
MILKY WAY
CELESTIAL EQUATOR
CELESTIAL MERIDIAN
PLANE OF THE HORIZON
PLANE OF THE PRIME VERTICAL
PLANE OF THE MERIDIAN
PLANE OF THE CELESTIAL EQUATOR
PLANE OF THE ECLIPTIC
PLANE OF THE GALACTIC EQUATOR
PLANE OF THE GALACTIC MERIDIAN
PLANE OF THE GALACTIC POLE

HELIOCENTRIC POSITIONS OF THE PLANETS, JUNE



SATELLITES OF THE SOLAR SYSTEM

Name	Stellar Mag.	Mean Dist. from Planet (Miles)	Revolution Period d	h	m	Diameter Miles	Discoverer
SATELLITE OF THE EARTH							
Moon	−12.6	238,857	27	07	43	2160	
SATELLITES OF MARS							
Phobos	12	5,800	0	07	39	10?	Hall, 1877
Deimos	13	14,600	1	06	18	5?	Hall, 1877
SATELLITES OF JUPITER							
V	13	112,600	0	11	57	100?	Barnard, 1892
Io	5	261,800	1	18	28	2300	Galileo, 1610
Europa	6	416,600	3	13	14	2000	Galileo, 1610
Ganymede	5	664,200	7	03	43	3200	Galileo, 1610
Callisto	6	1,169,000	16	16	32	3200	Galileo, 1610
VI	14	7,114,000	250	16		100?	Perrine, 1904
VII	16	7,292,000	260	01		40?	Perrine, 1905
X	18	7,300,000	260			15?	Nicholson, 1938
XI	18	14,000,000	692			15?	Nicholson, 1938
VIII	16	14,600,000	739			40?	Melotte, 1908
IX	17	14,900,000	758			20?	Nicholson, 1914
XII	18	—		—		15?	Nicholson, 1951.
SATELLITES OF SATURN							
Mimas	12	115,000	0	22	37	400?	W. Herschel, 1789
Enceladus	12	148,000	1	08	53	500?	W. Herschel, 1789
Tethys	11	183,000	1	21	18	800?	G. Cassini, 1684
Dione	11	234,000	2	17	41	700?	G. Cassini, 1684
Rhea	10	327,000	4	12	25	1100?	G. Cassini, 1672
Titan	8	759,000	15	22	41	2600?	Huygens, 1655
Hyperion	13	920,000	21	06	38	300?	G. Bond, 1848
Iapetus	11	2,210,000	79	07	56	1000?	G. Cassini, 1671
Phoebe	14	8,034,000	550			200?	W. Pickering, 1898
SATELLITES OF URANUS							
Miranda	17	81,000	1	09	56		Kuiper, 1948
Ariel	16	119,000	2	12	29	600?	Lassell, 1851
Umbriel	16	166,000	4	03	28	400?	Lassell, 1851
Titania	14	272,000	8	16	56	1000?	W. Herschel, 1787
Oberon	14	364,000	13	11	07	900?	W. Herschel, 1787
SATELLITES OF NEPTUNE							
Triton	13	220,000	5	21	03	3000?	Lassell, 1846
Nereid	19	3,460,000	359			200?	Kuiper, 1949

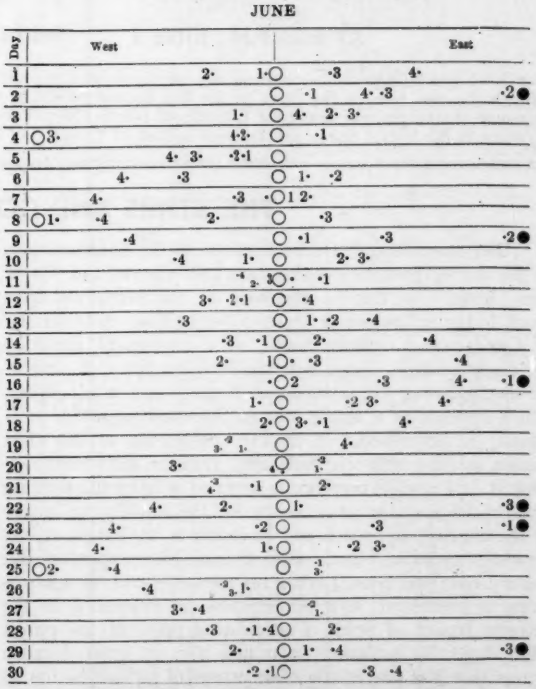
VENUS IN BROAD DAYLIGHT

On many occasions we have said that Venus or Mercury is best seen in broad daylight in the telescope. This is true. If your telescope is equiped with setting circles, either planet is easily picked up in broad daylight, although it helps in observing if the telescope is shielded from the direct sun. Daylight tends to reduce the glare of Venus, and the disc stands out sharply against the blue sky. This planet can be seen almost up to the day of conjunction with the Sun, which is not difficult at inferior conjunction since Venus is often over five degrees north or south of the Sun. At inferior conjunction it will present a big and extremely thin crescent shaped disc, the arms of the crescent going more than half way, due to sunlight shining through the planet's atmosphere. We have seen objects much fainter than either Mercury or Venus, in the telescope, in broad daylight. In fact, with a twelve-inch reflector, both Mizar and Alcor in Ursa Major, magnitudes 2.4 and 4.0, respectively) were easily seen at noontime.

Venus can be seen in broad daylight *with the naked eye* just as easily as Alcor can be seen in a telescope. After all, Venus is some eight magnitudes brighter than Alcor, which is about equal to the ability of a twelve inch telescope to out-perform the naked eye. However, the problem lies in knowing exactly where to look for Venus. Here is a simple method. On the 17th of June, at noontime (EST) Venus and Arturus are at the same declination. This means that for a few days around the 17th Venus will appear in the same general place in the sky as Arcturus, but 18 hours and 39 minutes later. So, on some clear June evening on the 15th, 16th, 17th or 18th, locate Arcturus, and line it up with reference to the edge of a roof, or some branch of a tree, etc., being sure to mark the spot where you are standing. Then, 18 hours and 39 minutes later, stand on the same spot, look toward your reference point, and, though the Sun is shining brightly, you will see Venus without difficulty!

SATELLITES OF JUPITER

JUNE



Appearance of Jupiter and its satellites at 11:45 P.M., E.S.T. as seen in an inverting telescope

XUM

EVENING SKY MAP FOR JUNE

AT 9:30 P.M., JUNE 1 8:30 P.M., JUNE 15 7:30 P.M., JUNE 30

Face South and hold the Map overhead, the top North, and you will see the stars and planets just as they appear in the heavens. The arrow through the two stars in the bowl of the Big Dipper points to the North Star, the star at the end of the handle of the Little Dipper. This map is arranged specifically for Latitude 40 North—New York—but is practical for ten or fifteen degrees north or south of this latitude anywhere in the United States, the southern portion of Canada and the northern portion of Mexico and for corresponding latitudes in Europe.

THE STARS AND CONSTELLATIONS IN JUNE

The most beautiful constellations in the Southern part of the sky in the June evenings are Leo, Corvus and Virgo. The "Sickle" of Leo is seen west of the Meridian; then much lower in the South appears the striking quadrilateral of Corvus, and directly South, at a convenient elevation for observation, is Virgo with the brilliant Spica, its brightest star, glowing like a diamond of the purest water. Spica, which appears as a single star in the most powerful telescopes, is nevertheless a double, belonging to the class known as "spectroscopic binaries," because the companion body is dark and its presence is revealed only by the shifting lines in the spectrum, the motion of the lines being caused by the alternate approach and recession of the bright star as it swings round and round with its invisible companion. But the ordinary spectator, having no telescope and no spectroscope at command, will nevertheless be interested in the extreme beauty of Spica, a scintilating point of the purest white light. Its brilliancy combined with its great distance proves that it is one of the most powerful radiant bodies in the Universe.

Away over in the Southeast appears one of the most remarkable of the constellations, Scorpio, marked by the presence of a brilliant red star of the first magnitude—Antares. This also is a double, which may be separated with a telescope of four inches aperture. The samll companion star is of a rich green color, contrasting beautifully with the red hue of its greater neighbor. But it can be better seen in July when it is nearer the meridian and farther removed from the mists and the unsteady air of the horizon.

High overhead, following the handle of the Great Dipper, is the splendid constellation Bootes is often called the "Bear Driver." The brightest star in the constellation, and one of the brightest in the whole sky, is Arcturus. The reader should notice the huge triangle whose corners are marked by Arcturus, Spica and Denebola, (or Beta Leonis), in Leo. The distance between Spica and Arcturus is somewhat more than thirty degrees.

East of Bootes shines the circle of the Northern Crown (Corona Borealis), and in the Northeast with resplendent rays glitters the beautiful Vega in the constellation Lyra. The Great Dipper is high overhead with handle to the east, and Cassiopeia is low upon the horizon in the north.

THE STUDY OF OUTER SPACE—Continued from Page 7

the coordinates of the sun and moon. The problem assumes that a rocket is 350 miles from the earth's surface, with its velocity in space at this point being one of the variables. To be determined are the initial and final velocity, and the tolerance required in order to hit various locations on the moon, such as the crater Plato.

This is known to mathematicians as a two-boundary point problem, which utilizes the beginning and end point positions of two constants of integration for the solution of three simultaneous second-order differential equations. The Univac system is programmed to utilize these equations in determining the beginning and end velocity of the rocket.

Still other complex, high priority problems this electronic giant has been solving since its installation at WADC in 1956 are: nuclear reactor characteristics; human response to high-performance aircraft; physiological effects of gravitational stress; chemistry of flames and related studies of motion; Bomarc and Sidewinder missiles; sound phenomena and research problems on the use of solar energy.

SYSTEMS MAGAZINE

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The Star Field makes an apparent complete revolution westward every 24 hours, hence the hourly division from I to XXIV, but this has no relation to the time that any portion of the map is in view. Practical as a Star, Constellation and Planet Finder for the month indicated. Anywhere in the world.

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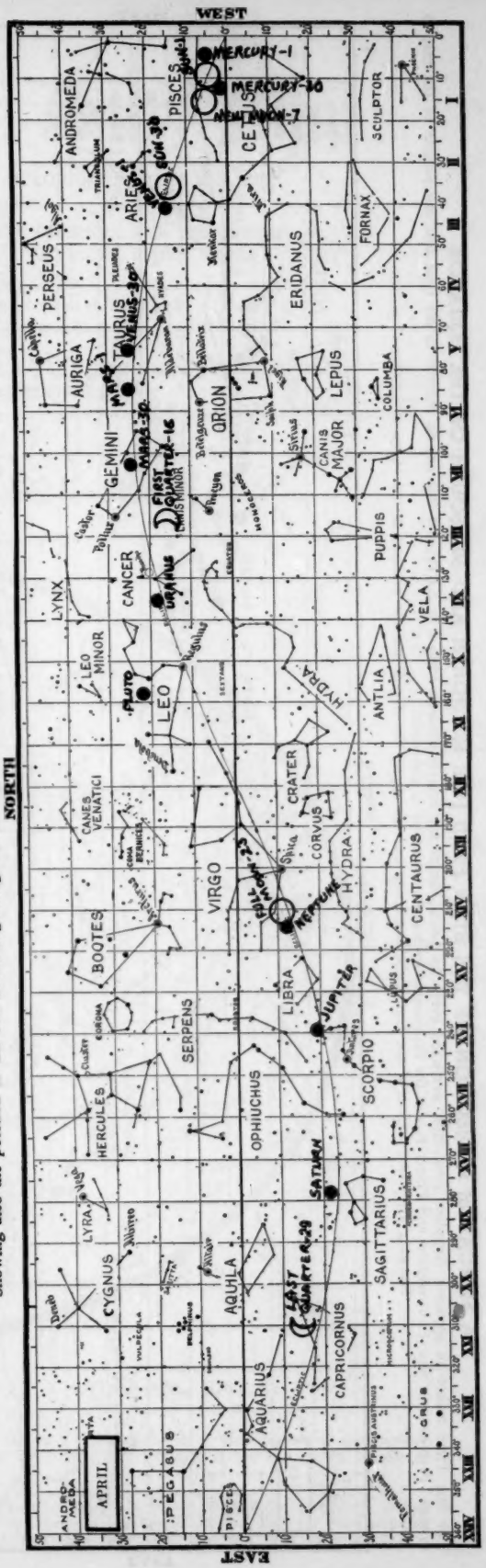

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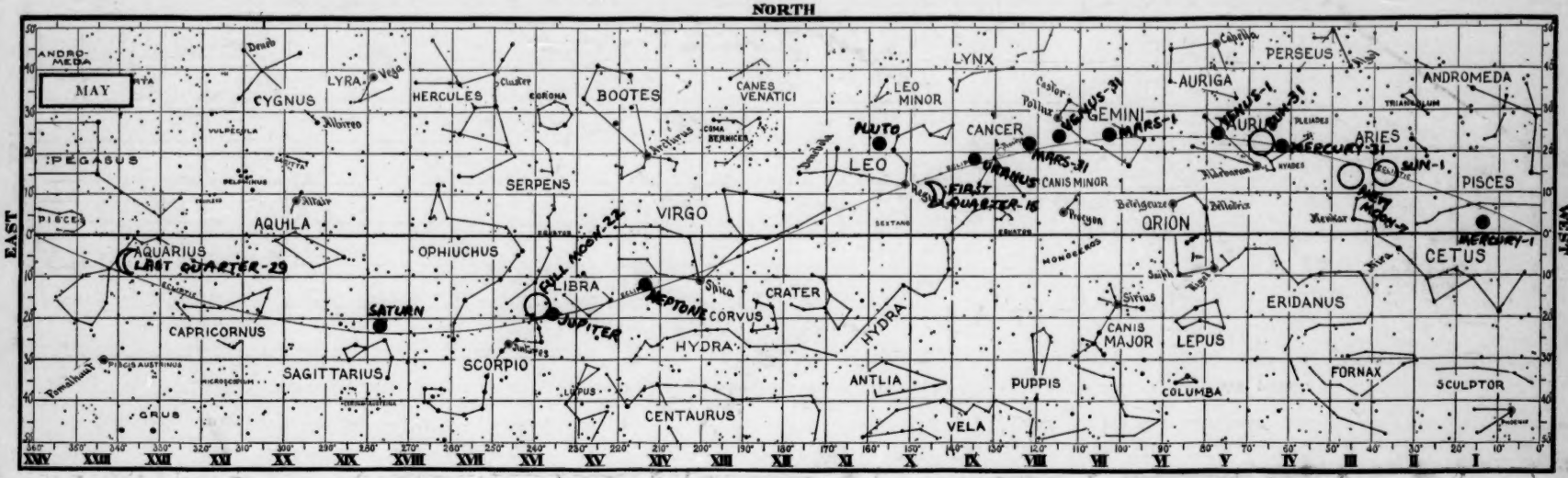

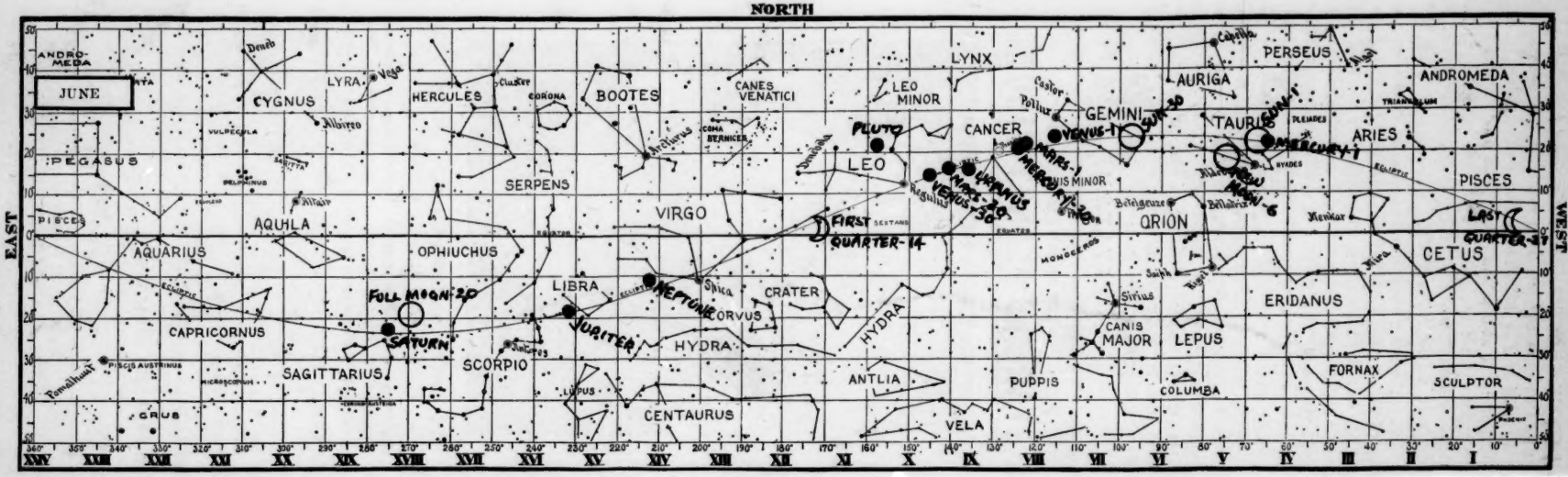

Nov. 5 Oct. 22 Oct. 5 Sept. 20 Sept. 5 Aug. 20 Aug. 5 July 20 July 5 June 20 June 5 May 20 May 5 Apr. 20 Apr. 5 Mar. 20 Mar. 5 Feb. 18 Feb. 2 Jan. 20 Jan. 5 Dec. 20 Dec. 5 **Nov. 20**

THE DATE BELOW EACH NUMERAL WILL SHOW WHEN THAT SECTION OF THE MAP WILL BE ON THE MERIDAN—DUE SOUTH—AT 9 P.M. OR AN HOUR EARLIER FOR EACH NUMERAL WEST OF THIS DATE AND AN HOUR LATER FOR EACH NUMERAL EAST

XUM